Fiscal policy and economic growth: empirical evidence from EU countries

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This paper studies whether a reallocation of the components of public spending and revenues can enhance economic growth using data on 14 EU countries during 1990-2006. The results provide support for endogenous growth models. Specifically, the findings are: a) public expenditures on infrastructure (economic affairs, general public services) and property rights protection (defense, public order-safety) exert a positive impact on growth; b) distortionary taxation depresses growth; c) government expenditures on human capital enhancing activities (education, health, housing-community amenities, environment protection, recreation-culture-religion) and social protection do not have a significant growth effect. However, when coefficient heterogeneity across countries along with non-linearities are taken into account and public expenditures are further disaggregated, we have in addition that government outlays on education, defense and social protection are growth-enhancing. These findings are robust to changes in specification and estimation methodology.

Keywords: Panel Data. Fiscal Policy. Taxation. Government Expenditures.

JEL Classification: C23, E62, H2, H5.

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1. INTRODUCTION

The role of fiscal policy in the long-run growth process has been central in macroeconomics especially since the appearance of endogenous growth models. Different authors have focused on different types of fiscal policy as engines of balanced growth.

Also, much empirical work has been done to test the predictions of theoretical models, but the results differ greatly between studies. Levine-Renelt (1992) and Agell et al. (1997) have emphasized the sensitivity of the findings to changes in the set of control variables. A problem with most studies is that they do not test the growth effects of fiscal policy taking into account the structure of both taxation and expenditure, i.e. they focus on the one side of government activity ignoring, at least partially, the other. Kneller et al. (1999), Bleaney et al. (2001), were the first to show that studies, which do not take into account both sides of the budget, suffer from substantial biases of the coefficient estimates, to be followed by others (Angelopoulos et al., 2007, Romero-Avila-Strauch, 2008).

In this paper, we contribute to the literature on the growth impact of fiscal policy in various ways. First, we use the most recent dataset regarding fiscal variables, since the change in their construction and classification in 2001. Second, we use data for general government, not central government as most related literature. This is more appropriate since, first overall government activity is relevant from an economic point of view and general government data are more homogeneous than central government data, which vary with the degree of fiscal centralization of the countries. Third, we include a richer menu of policy effects and sub-categories of spending-taxes than most previous studies as potential determinants of growth. Fourth, regarding the misspecification of the growth equation related to the government budget constraint, we conduct our estimations from a general to specific specification by omitting variables with statistically insignificant growth effects. Fifth, we allow for differential growth impact as well as non-linear effects of fiscal policy across countries. Sixth, we test for lagged effects on growth of variables for which theory and intuition would suggest so and allow the data to determine the appropriate number of lags in static and dynamic panel data models. In this context, we employ different lag structures as a check of robustness of our results. Seventh, we employ alternative estimation methods appropriate for panel data of satisfactory quality, as a check of robustness of our results. In this framework, we apply GMM estimation techniques, not simply IV estimation used in most of the literature, to deal with potential endogeneity problems.

So, we find that most types of government expenditures and taxation matter for growth. Specifically, public expenditures on infrastructure (economic affairs and general public services) exert a positive impact on growth. Moreover, government outlays on property rights protection (defense, public order-safety) have a positive effect on per capita growth. Also, distortionary taxation depresses growth. Furthermore, government expenditures on human capital enhancing activities (education, health, housing-community amenities, environment protection, recreation-culture-religion) and social protection do not have a significant effect on per capita growth. However, when coefficient heterogeneity across countries is taken into account and public expenditures are disaggregated further, we have in addition that public outlays on education, defense and social protection have a positive growth effect.

The rest of the paper proceeds as follows. Section 2 outlines the basic implications of the endogenous growth models for fiscal policy and of the government budget constraint for empirical testing. Section 3 summarizes the existing empirical work on fiscal policy and growth. Section 4 presents our data and econometric methodology, while section 5 comments on our results. Section 6 concludes the paper.

2. PREDICTIONS OF GROWTH MODELS WITH FISCAL POLICY

Neoclassical growth models imply that government policy can affect only the output level but not the growth rate (Judd, 1985). However, endogenous growth models incorporate channels through which fiscal policy can affect long-run growth (Barro 1990, Barro-Sala-i-Martin 1992, 2004).

The latter models classify generally the fiscal policy instruments into: a) distortionary taxation, which weakens the incentives to invest in physical/human capital, hence reducing growth; b) non-distortionary taxation which does not affect the above incentives, therefore growth, due to the nature of the utility function assumed for the private agents; c) productive expenditures that influence positively the marginal product of private capital, henceforth boost growth; d) unproductive expenditures that do not affect the private marginal product of capital, consequently growth, but increase household utility directly.

The endogenous growth models predict that an increase in productive spending financed by non-distortionary taxes will increase growth, whilst the effect is ambiguous if distortionary taxation is used. In the latter case, there is a growth-maximizing level of productive expenditure, which may or may not be Pareto efficient (Irmen-Kuehnel, 2008). Also, an increase in non-productive spending financed by non-distortionary taxes will be neutral for growth, while if distortionary taxes are used the impact on growth will be negative.

Various extensions of the basic endogenous growth models with fiscal policy have been worked out, allowing publicly-provided goods to be productive in stock and/or flow form (e.g. Futagami et al., 1993, Cashin 1995, Turnovsky 1997, Tsoukis-Miller, 2003, Ghosh-Roy, 2004, Agenor, 2008), different forms of expenditure to be productive (e.g. Devarajan et al. 1996, Sala-i-Martin 1997, Glomm-Ravikumar 1997, Kaganovich-Zilcha 1999, Zagler-Durnecker, 2003, Gomez, 2007), various forms of taxation (Ortigueira, 1998) and asymmetric equilibria ex-post (Glomm-Ravikumar 1992, Chang 1998). Also, there is research on models with adjustment costs (Hayashi, 1982, Turnovsky, 1996a), congestion effects (Glomm-Ravikumar, 1994, Eicher-Turnovsky, 2000, Ott-Turnovsky, 2006, Ott-Soretz, 2007), utility-enhancing public consumption (Cazzavillan, 1996, Turnovsky, 1996b) and endogenous labour supply (Turnovsky, 2000, Raurich, 2003). Finally, work has been done on small open economies (Turnovsky, 1999a), public capital maintenance (Rioja, 2003, Kalaitzidakis-Kalyvitis, 2004), stochastic environments (Turnovsky, 1999b), increasing social returns (Abe, 1995, Zhang, 2000) and non-scale growth (Eicher-Turnovsky, 2000, Pintea-Turnovky, 2006).

Turning to the specification issue mentioned in the introduction of the paper, we refer shortly to the analysis by Kneller et al.(1999)[1]. They basically concluded that the equation being estimated typically by the researchers who investigate the effect of fiscal policy on growth takes the form $G_{it} = a + \sum_{i=1}^{k} b_i E_{it} + \sum_{j=1}^{l-1} \left(c_j - c_l\right) F_{jt} + u_{it}$ (1)

[1]A later work that focuses on the same issue regarding only public education spending is by Blankenau et al (2007).

In (1), G_{it} is the growth rate of country i at time t, which is a function of non-fiscal variables, E_{it} , and fiscal variables, F_{jt}. Additionally, a and b_i represent the constant term and the slope coefficient of the non-fiscal variable i (there are k such variables) respectively. Also, c_j is the coefficient of the growth impact of the variable F_{jt}, one of $l-1$ fiscal variables, and c_l measures the effect on growth of the lth fiscal variable, which finances the change in one of the $l-1$ fiscal policy instruments.

From equation (1), we see that the hypothesis test of zero coefficients for F_{jt} usually conducted in empirical studies, tests the hypothesis that $c_j - c_l = 0$, and not $c_j = 0$, as implicitly assumed. So, we actually estimate the impact of a change in one fiscal variable when there is an offsetting change in the omitted lth fiscal variable, which implicitly finances the variation in the variable of interest. If the omitted category is modified, the coefficient of F_{jt} will be different. This implies that the researcher has either to omit a fiscal instrument with negligible effect on growth, i.e. one for which $c_l = 0$, or to omit two fiscal variables for which the hypothesis that $c_j = c_l$ can not be rejected. So, it is necessary to test down from the full-fledged specification to less complete specifications omitting only variables with negligible growth effects.

3. EMPIRICAL LITERATURE REVIEW

Many studies of the relationship between fiscal policy and growth were conducted before the relevant endogenous growth models were developed, i.e. from the early 1980s. For example, Landau (1983) using cross-sectional data from 104 countries found a negative relation between public consumption as share of GDP and growth per capita using Summers-Heston data, while Kormendi-Meguire (1985) using cross-section/time-series data for 47 countries found no statistically significant relation of the same variables for the post-World War II period. Barro (1989), with data from 98 countries in the post-World War II period, found that government consumption decreases per capita growth, while public investment does not affect growth. Levine-Renelt (1992) found that most results from earlier studies on the relationship between long-run growth and fiscal policy indicators are fragile to small changes in the conditioning set.

In the next generation of studies, Easterly-Rebello (1993) used cross-section data for 100 countries for 1970-1988 and panel data for 28 countries for 1870-1988. They found that public transportation, communication and educational investment are positively correlated with growth per capita and aggregate public investment is negatively correlated with growth per capita, although they admitted that many fiscal policy variables are highly correlated with initial income levels and fiscal variables are potentially endogenous. Cashin (1995) estimated a positive relationship between government transfers, public investment and growth and a negative one between distortionary taxes and growth from panel data for 23 developed countries during 1971-1988. Devarajan et al (1996) showed that public current expenditures increase growth, whilst government capital spending decreases growth in 43 developing countries over 1970-1990. Kneller et al. (1999), Bleaney et al. (2001) showed that the biases related to the incomplete specification of the government budget constraint present in previous studies (see section 2 above) are significant and after taking them into account, they found for a panel of 22 OECD countries for 1970-1995 that: (1) distortionary taxation hampers growth, while non-distortionary taxation does not; (2) productive government expenditure increases growth, while non-productive expenditure does not; (3) long-run effects of fiscal policy are not fully captured by five-year averages commonly used in empirical studies. Poot (2000) in a survey of published articles in 1983-1998 did not find conclusive evidence for the relationship between government consumption and growth, while he found empirical support for a negative growth effect of taxes. Also, he reported a positive link between growth and education spending, while the evidence on the negative growth impact of defense spending was moderately strong. Finally, Poot presented evidence of a robust positive association of infrastructure spending and growth. Easterly (2005) found a significant growth effect of budget balance, which disappeared when extreme observations were excluded from the analysis. Afonso-Alerge (2007) examining four functional categories of public expenditures estimated a negative impact of health, social protection expenditures and a positive impact of education expenditure on growth for EU-15 in 1990-2006. Angelopoulos et al. (2007) concluded that productive government expenditure, capital income and corporate income taxes are growth-enhancing, while labour income taxes are growth-reducing for 23 OECD countries in 1970-2000. Romero-Avila-Strauch (2008) found that government size affects negatively

GDP pc growth and public investment has a positive effect on growth for EU-15 in 1960-2001.

It therefore seems that there is widespread non-robustness of coefficient signs and statistical significance even within similar specifications for similar variables. The most important explanation for these differences, in our opinion, is the absence of a generally accepted theoretical framework to guide the empirical research (Galor, 2005). If such a framework were available, we could test the statistical significance of the postulated fiscal and non-fiscal determinants of growth and avoid the omitted variable bias that empirical results possibly suffer. Another issue is the classification of expenditure types as productive/unproductive, a question over which there is some debate in theoretical literature (Kneller et al., 1999). Another problem of most empirical studies of growth and fiscal policy concerns the misspecification of the growth equation in relation to the government budget constraint (see section 2 above).

In addition, existing empirical studies on fiscal policy and growth differ in terms of countries included in the sample, period/method of estimation and measures of public sector activity. Data quality is also a problem since, various countries have different conventions for the measurement of public sector size and there are limited data at the required level of disaggregation, implying measurement errors. Also, the dynamic effects of fiscal policy are either ignored completely or not modeled carefully in existing empirical work, i.e. not sufficient attention is paid on distinguishing the transitional from the long-run policy effects. Moreover, even if there is correlation between explanatory variables and the rate of growth, the direction of causation is not clear (Wagner's law). Besides these, there might be correlation of fiscal variables with initial GDP (Easterly-Rebello, 1993).[2] Furthermore, the linear structure imposed on most empirical models is convenient but not necessarily realistic and consistent with the underlying theory (Liu-Stengos, 1999, Kalaitzidakis, 2001). In addition, testing for parameter heterogeneity is not conducted in most studies.

In our work, we take most of the above problems into account and refine existing research, disaggregating government spending and revenue, searching for evidence that is robust to changes in specification and estimation method as explained below.

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[2] This is not a serious issue in our case, since most respective correlations are low (see Table A2 in Appendix).

4. DATA AND ECONOMETRIC METHODOLOGY

As mentioned in Section 2, endogenous growth models assume a classification of fiscal instruments into four types, i.e. productive/unproductive expenditures and distortionary/non-distortionary taxation. However, regarding government spending, the theoretical literature is not clear about the classification of the various functional categories, so we simply mention them leaving the estimation results to determine whether these categories are productive or unproductive contrary to other research which imposes such a classification a priori (Kneller et al., 1999, Angelopoulos at al., 2007). As a result, we aggregate the various fiscal variables using the functional classification of the EU as shown in Table 1. The aggregation of the budgetary components by function is chosen in our analysis, because we think it corresponds more closely to the theoretical classification of fiscal variables by endogenous growth theories (see beginning of section 2) compared to the classification by type employed by other studies (Romero-Avila-Strauch, 2008).

Table 1. Theoretical/Functional classification of fiscal policy instruments

Theoretical classification	Functional classification
Distortionary taxation	Current taxes on income, wealth
	Capital taxes
	Actual social contributions
Non-distortionary taxation	Taxes on production and imports
Productive/unproductive government expenditures	Expenditure on education
	Expenditure on health
	Expenditure on housing-community amenities
	Expenditure on environment protection
	Expenditure on social protection
	Expenditure on economic affairs
	Expenditure on general public services
	Expenditure on public order-safety
	Expenditure on defense
	Expenditure on recreation-culture-religion

Note: functional classifications refer to the classifications given in the data sources.

We use an unbalanced panel data set covering 14 EU countries. The number of countries was limited by the requirement of at least 10 observations per country imposed by us, so that we can study long-run growth. The observations are annual, cover the period 1990-2006 and are obtained from Eurostat[3].

Table A1 displays the basic descriptive statistics for the variables used in the estimations (for variables' definitions see A1 in Appendix). We see that per capita income grew at about 2.2% per annum. Public spending on education (*GEDY*) and health (*GHEAY*) was about the same, approximately 5.5% and 5.8% of GDP respectively. Government expenditures on housing-community amenities (*GHOCOY*) and environment protection *(GENPRY)* were equal to 0.9% and 0.6% respectively, while spending on recreation-culture-religion *(GRRY)* was 1%. Social spending (*GSPROY*) was the largest component of public spending with about 18.4%, while expenditure on economic affairs (*GEAFY*) was around 4.6% of GDP. Besides these, government spending on public-order safety (*GPUBSY*) and defense (*GDEFY*) amounted to 1.5% and 1.7% of GDP respectively. These expenditures were financed mainly by taxes on income and wealth (*TIWY*), taxes on production and imports (*TPRIMY*) and social security contributions (*ACSY*), which amounted to 14.7%, 13.7% and 11.9% of GDP respectively. Capital taxes (*CAPTY*) accounted for only 0.2% of GDP. The budgets (*DEDPY*) were on deficit of 2%. Here, we should note that for most variables there is large variation across countries and over time. For example, growth ranges from –7% to 13.3%, spending on education was as low as 2.5% and as high as 8.2% of GDP and health expenditures are between 0.9% and 7.7%. Also, social spending ranges from 7.8% to 28.4% of GDP. Furthermore, taxes on income and wealth are from 6.4% to 31.2% and we observe deficit equal to 9.5% and surplus of 6.9% of GDP.

As far as the remaining variables used in the estimations, for human capital we employed the percentage of the population aged 20-24 with at least upper secondary education (*UPSEC*) being equal to 73.9% and the percentage of active population which has completed tertiary education and is employed in S&T occupations (*HRSTCOR*) was 15%. Employment growth (*EMPGR*) was 1% per year, private investment (*PRIY*)[4] was around 17.5% of GDP, while exports (*XY*) and imports (*MY*) accounted for 48.6% and

[3] The methodology of construction and the classification of fiscal variables changed in 2001 and there are no consistent data before 1990 (Gemmell et al, 2007).

[4] The use of private investment instead of total investment ensures there is no double counting of public investment, since the latter is included in the government expenditure.

45.1%, respectively. In all cases there is large variation in the values of the variables in both the time and country dimensions.

Turning to the specification of our econometric model, we proceed in the spirit of Kneller et al. (1999), Bleaney et al. (2001), but refine their work in some ways. First, we use the most recent fiscal consistent dataset compiled by Eurostat after the change in the construction and classification of fiscal variables in 2001. Second, we use data for general government, not central government as they do. Third, in the equation to be estimated, we include all the elements of the government budget constraint but decompose them further compared to these works. Initially, we classify the various categories of expenditures and revenues into homogeneous groups in order to reduce the number of explanatory variables and increase the efficiency of our estimates, since we do not have a very large number of observations. We incorporate public spending on education, health, housing-community amenities, environment protection and recreation-culture-religion in the variable *GHY*, which includes expenditures that enhance human capital accumulation. The new variable represents 14% of GDP on average, but ranges from 4.8% to 18.3%. Furthermore, we construct the variable *GINFY*, which comprises public spending on economic affairs and general public services that improve infrastructure, since they concern among others transportation, communication etc. These expenditures correspond to 13% of GDP varying between 7% and 25.1%. Also, we define *GPRY* as government expenditure on property rights protection, because it includes outlays on defense and public order-safety. These absorb 3.2% of GDP on average ranging from 1.2% to 6.5%. We leave spending on social protection (*GSPROY*) as a separate category and include budget balance (*DEDPY*) as an additional variable to complete the budget. Furthermore, we create *DTY* for distortionary taxation, which contains taxes on income-wealth, capital taxes and social security contributions. These taxes are 26.8% of GDP on average, but vary from 16% to 35.8%. We assume that non-distortionary taxes are the implicit financing elements of a change in the rest of the fiscal variables, therefore we omit them from the regressions.[5] Fourth, we allow for differential growth impact of fiscal policy instruments across countries.

[5] Additionally, we included in our model public debt as a percentage of GDP to examine potential effects of the level of indebtness on growth. However, it was not found statistically significant, so the respective estimations are not presented in the paper, but are available upon request.

Regarding non-fiscal variables, we incorporate initial GDP per capita *(Y0)* and lagged per capita growth to isolate possible convergence effects. We also include investment as a proportion of GDP (*PRIY)* and employment growth (*EMPGR)* in our equation, since capital and labour are the main factors of production in growth models. Besides that, *EMPGR* controls for business cycle effects on growth. Furthermore, we incorporate the percentage of the population aged 20 to 24 having completed at least upper secondary education (*UPSEC)* and alternatively*,* persons who have completed tertiary education and are employed in S&T occupations as percentage of active population (*HRSTCOR).* These variables were included in order to take into account the growth effects of human capital in our economies. Thus, the estimated coefficients of the fiscal variables measure the growth impact of policies beyond their effect on physical and human capital accumulation. Finally, we use the sum of imports and exports as a proportion of GDP (*OPEN),* accounting for external effects on the economies, which equals on average 93.7% of GDP.

Finally, since empirical evidence suggests that there are lagged effects of fiscal policy on growth, in order to distinguish the effects of policy during transition from those on the steady state, we use sums of contemporaneous and lagged values of the relevant variables in our models. However, we allow the data to determine the appropriate number of lags for each variable.

As a result, we estimate the following model:

$$
\begin{aligned}
YG_{it} = {} & a_0 + a_1 C + a_2 \sum_{b=0}^{c} GHY_{it}(-b) + a_3 \sum_{b=0}^{d} GINFY_{it}(-b) + a_4 \sum_{b=0}^{e} GPRY_{it}(-b) + a_5 \sum_{b=0}^{f} GSPROY_{it}(-b) + \\
& + a_6 \sum_{b=0}^{g} DTY_{it}(-b) + a_7 \sum_{b=0}^{h} DEDPY_{it}(-b) + a_8 \sum_{b=0}^{j} H_{it}(-e) + a_9 \sum_{b=0}^{k} EMPGR_{it}(-b) + a_{10} PRIY_{it} + \\
& + a_{11} OPEN_{it}
\end{aligned}
$$
[6] (2)

After the estimation of (2), we refine the analysis disaggregating some components of public spending to check if the initial results are robust or which is the source of non robustness. Specifically, we isolate public education expenditure from the remaining spending on human capital accumulation, since we expect the former to have a stronger growth impact compared to the other spending components in the group of developed countries we study. This is because e.g. the health status of the population is already quite high in our sample, so that additional health expenditure may not have strong growth effects. On the contrary, rapid technological progress renders continuous improvement of the education of population necessary for long-run growth. Also, we decompose expenditure on property rights protection into military and non-military spending to check if there is a difference in their growth impact.

At the same time, we deal with the possibility of differential growth effects of various fiscal variables across countries.[7] So, we use government expenditures multiplied by initial income per capita, since there is literature indicating that initial conditions matter for the growth effect of various factors (Azariadis-Drazen, 1990, Durlauf-Johnson, 1995, Minier, 2007). However, infrastructure spending is multiplied by the initial level of infrastructure, which is considered more appropriate to represent initial conditions for this variable. Especially for education expenditures, we use alternatively its product with the initial value of our two human capital indicators *(UPSEC, HRSTCOR)* to investigate the possibility that the impact of such spending varies with the initial education level.

So, we estimate the following model:

$$
\begin{aligned}
YG_{it} &= \beta_0 + \beta_1 C + \beta_2 \sum_{b=0}^{c} GEDUYY0_{it}(-b) + \beta_3 \sum_{b=0}^{d} HYRY0_{it}(-b) + \beta_4 \sum_{b=0}^{e} GINFYM0_{it}(-b) + \\
&+ \beta_5 \sum_{b=0}^{f} GDEFYY0_{it}(-b) + \beta_6 \sum_{b=0}^{g} GORSFYY0_{it}(-b) + \beta_7 \sum_{b=0}^{h} GSPROYY0_{it}(-b) + \\
&+ \beta_8 \sum_{b=0}^{j} DTY_{it}(-b) + \beta_9 \sum_{b=0}^{k} DEDPY_{it}(-b) + \beta_{10} \sum_{b=0}^{l} H_{it}(-e) + \beta_{11} \sum_{b=0}^{m} EMPGR_{it}(-b) + \\
&+ \beta_{12} PRIY_{it} + \beta_{13} OPEN_{it}{}^{8} \qquad (3)
\end{aligned}
$$

Regarding estimation methodology, empirical panel data studies on growth are usually carried out for periods of around 30 years, with five-year averaged observations to isolate business cycle influences on growth (Kneller et al., 1999, Folster-Henrekson, 2001, Angelopoulos et al, 2007). However, first, this implies loss of information and efficiency of estimates and second, the lack of synchronicity in country business cycles

[6] C stands for the variables representing convergence, which correspond to initial income per capita and lagged per capita growth, while *H* represents *UPSEC* and *HRSTCOR* depending on the specification.

[7] Pesaran-Smith (1995) argued that assuming incorrectly these effects are homogeneous across countries will likely imply biased coefficient estimates.

[8] Definitions of the new variables are in the Appendix. The variable *GEDUYY0* is replaced in some versions of (3) by *GEDUYUS0* or *GEDUHC0*. In the same spirit, *GHYRY0* is replaced by *GHYRUS0* or *GHYRHC0* (see discussion in the first paragraph of this page).

does not purge five-year averages from cyclical effects (Bassanini, et al, 2001). Also, we have 17 years of data. Hence, we use annual observations.

Furthermore, we apply OLS and panel econometric techniques.[9] OLS assume that the error in each time period is uncorrelated with the explanatory variables in the same period. Panel data analysis offers several advantages over time series and cross-section techniques. It allows for more efficient parameter estimates,[10] uncovers dynamic relations[11] and identifies otherwise unidentified models.[12]

So, we initially estimate our models by OLS and select the appropriate model specification using the Akaike Information and Schwartz Bayesian Information Criteria as selection criteria.[13] However, a primary motivation for using panel data is to solve the problem of omitted variables, which are effectively part of the error term and cause bias in the coefficient estimates. In light of that, we assume that there is a time-constant unobserved effect, which may represent country-specific technology, tastes, historical and cultural factors and proceed with fixed effects estimation.[14]

However, although the main premise informing the present work is the effect of fiscal variables on GDP per capita growth, the association does not mean that causality runs exclusively in one direction. If this is not taken into consideration, biased and inconsistent estimates will be obtained. To account for this problem, we employ a GMM estimator developed by Arellano and Bond (1991).[15] This requires first differencing and lags of the dependent and explanatory variables as instruments. First differencing removes country-specific effects, which are a potential source of omitted variable bias and deals with series non-stationarity.

In addition, we apply the enhanced Arellano and Bover (1995) - Blundell and Bond (1998) estimator. Blundell-Bond (1998) showed that the lagged level instruments in the

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[9] We do not conduct explicit econometric testing of the cross-equation overidentifying restrictions implied by any particular model. Also, we do not work in the RBC tradition in order to reproduce the main moments of the data.

[10] See Hsiao-Mountain and Ho-Illman (1995).

[11] See Pakes-Griliches (1984)

[12] See Biorn (1992), Griliches-Hausman (1986).

[13] It is hard to derive adequate selection criteria for the conditioning variables, see e.g. Bellettini et al, (2000).

[14] Depending on the assumption about the correlation between the unobserved effect and the explanatory variables, two different estimation methods can be followed: either the random or the fixed effect one. The Hausman (1978) specification test is employed in order to examine the significance of the above correlation and shows that the Fixed Effects (FE) estimator is appropriate.

[15] For further details see Bond (2002) and Baltagi (2002).

Arellano-Bond (1991) estimator become weak as the autoregressive process becomes too persistent or the ratio of the variance of the panel-effects to the variance of the idiosyncratic error becomes too large. So, building on Arellano-Bover (1995), Blundell-Bond (1998) proposed a system GMM estimator that uses moment conditions in which lagged differences are used as instruments for the level equation, in addition to the moment conditions of lagged levels as instruments for the differenced equation. This estimator produces more accurate and efficient estimates compared with the Arellano-Bond (1991) estimator. In a nutshell, we are more confident about the two GMM estimators compared with FE/OLS estimators and emphasize the former. At the same time, if the findings are similar, this is a signal of robustness.

5. EMPIRICAL RESULTS

We try models with up to three lags to account for the cumulative impact of our model's variables on growth, in order to maintain a sufficient number of observations, which is necessary to derive reliable inferences.[16] We assume that non-distortionary taxes are the implicit financing elements of changes in the other fiscal variables, so we omit them from the regressions (see section 2, p. 4)

The preferred models according to the information criteria are those involving mostly three lags. The relatively large number of right hand-side variables and lags imply that the number of countries involved in the estimations is fourteen (see the Appendix for a list of countries). We report the estimation results for the preferred static and dynamic panel models in Tables A3-A4 using the four estimators analyzed in the previous section.

Public expenditures on human capital

We begin the discussion with policies, which affect human capital accumulation, i.e. the quantity and quality of human capital, by noting that government spending on human capital enhancing activities (*GHY*) does not seem to affect growth in a statistically significant way in the first round of regressions (Table A3).

[16] This lag length may seem short, but it is compatible with recent research which suggests that the long-run effects of fiscal policy are typically attained within a few (1-5) years. Moreover, the inclusion of lagged GDP growth ensures that the impact of shocks to the fiscal variables can persist for many years (Gemmel et al, 2007).

This apparently surprising result may be due to various factors. First, the variable used here is the sum of public spending on education, health, housing-community amenities, environment protection and recreation-culture-religion, since we do not have enough observations so as to include each of these elements separately in the equations estimated. So, if some elements have a significant growth effect and others do not, the aggregate effect estimated may be insignificant. Another possibility is that the effects of public expenditure on human capital are non-linear, e.g. quadratic, in which case it may be that actual public spending is close to the growth-maximizing level (see Karras 1996, Kalaitzidakis et al, 2001, Benos, 2005, for evidence on non-linear effects of spending on education, health and housing). If this is true, the effect of a change in spending on growth will be insignificant.

In order to tackle the above two problems, we proceed as follows. First, we disaggregate *GHY* into public education spending (*GDUY*) and the rest of expenditures on human capital accumulation (*GHYR*) to correct for possible aggregation bias. Second, we multiply each of the two variables by initial income per capita (*Y0*) or initial human capital (*UPSEC0* and *HRST0*) to allow for possible non-linear growth effects. The findings present strong evidence of non-linearities, since we get a positive growth impact for both education expenditure (*GEDUYUS0, GEDUYHC0*) and non-education expenditure (*GHYRUS0*), which varies directly with the initial level of education. Here, we should note that the impact of the former type of spending is more robust, pointing to the importance of education expenditures relative to rest of human capital expenditures as expected. So, the more educated is the population of a country initially, the more beneficial a rise in expenditure on education is for its growth prospects.

Public expenditures on infrastructure

Public spending on infrastructure (*GINFY*) has a positive impact on growth. For example, an increase of such expenditure as a proportion of GDP by one standard deviation (3.5%) has a positive growth effect of 1.6%. This is expected, since it includes among others outlays on transportation, communication and energy. These types of spending imply positive externalities to private producers, raise their productivity, therefore enhance economic growth according to theoretical growth models (Barro, 1990). Our results are also consistent with evidence from Easterly-Rebello (1993), Kneller et al. (1999), Baldacci et al. (2004), Angelopoulos et al. (2007). Following the same logic with human capital expenditures, we used as an alternative explanatory variable the product of public infrastructure expenditure with the initial stock of infrastructure approximated by the ratio of motorway length of each country measured in kilometers to its area (*GINFYM0*). The evidence shows that infrastructure spending is more effective in terms of growth in countries with higher initial infrastructure stock, i.e. a non-linear growth impact is revealed here too.

Spending on property rights protection

We include expenditure on public order-safety and defense (*GPRY*) in our estimated equations as an attempt to test the view expressed in some growth models that these types of spending contribute to the protection of property rights increasing the probability that the citizens retain these rights to their goods and services (Barro-Sala-i-Martin, 2004).[17] Therefore, such models argue, the higher spending on public order-safety and defense are, the stronger the incentive agents have to accumulate human/physical capital and this enhances growth.

Our empirical results are equally encouraging, since we are able to detect a statistically significant positive impact of expenditure on property rights protection on growth. So, a one-standard deviation (1% of GDP) rise in spending on property rights protection will increase per capita growth on average by 3.7%. This is in line with findings of Bleaney et al. (2001).

Next, in line with our strategy for human capital spending, we decomposed *GPRY* into defense (*GDEFY*) and non-defense expenditures (*GORSFY*) multiplied by initial per capita income (*Y0*). The evidence reveals again non-linear growth effects of defense spending, which vary positively with *Y0*, while the findings are ambiguous for public-order and safety. So, initially richer countries enjoy more growth effective defense spending.

[17] Defense expenditures are considered to contribute towards protection of property rights of a country's citizens as a whole.

Social Spending

The initial evidence regarding social spending (*GSPROY*) suggests a non significant influence on growth. This is consistent with the mixed conclusions of both theoretical and empirical work on the subject. Specifically, many growth models predict that redistributive policies have a depressing effect on physical capital accumulation and growth (Feldstein, 1974), while others imply that social security expenditure may positively influence savings, the level and productivity of physical and human capital investment, employment, international competitiveness and growth (Cashin 1995, Bellettini-Ceroni, 2000, Lau et al., 2001 and Van Der Ploeg, 2003). Also, Atkinson (1999) in a survey of the literature concluded that the evidence on the relationship between the size of the welfare state and growth is mixed and Bleaney et al. (2001) including social expenditure in unproductive spending estimated an insignificant growth effect. Finally, it may be that the high correlation of social spending and distortionary taxation (0.79)[18] makes it impossible to estimate accurately the growth effect of the former variable.

However, when we employ the product of social spending with initial income per capita as an explanatory variable instead of simply *GSPROY*, we find a positive growth impact, which rises with *Y0*. In other words, when we account for coefficient heterogeneity, we find evidence of non-linearities, i.e. initially richer countries enjoy a stronger positive effect of social spending on growth than initially poorer ones.

Government revenues

Looking at the revenue side of the budget, we see that distortionary taxes (*DTY*) have a statistically significant negative impact on growth in most cases. Specifically, a one standard deviation reduction in distortionary taxes as a percentage of GDP (4.6%) implies a 3.5% rise in growth on average. This is in accordance with the predictions of theoretical growth models (Barro, 1990, Millesi-Ferreti-Roubini, 1998, Jones et al., 1993, Turnovsky, 2000). It is also in line with empirical evidence, when both sides of the budget are taken into account (Kneller et al., 1999, Bleaney et al., 2001). This finding persists when coefficient heterogeneity regarding the growth impact of government spending variables is taken into account.

A related item is budget deficit (*DEDPY*), which exerts an ambiguous impact on growth. Specifically, the evidence is divided equally between positive, negative and insignificant growth effects. So, our results cast doubt on the Ricardian Equivalence proposition, which argues that since a current surplus will finance future deficits through cuts in distortionary taxation or increases in productive spending, it causes an increase in the expected returns to current investment, therefore growth. However, there is theoretical literature suggesting that turnover in the population and failure of the permanent income hypothesis of consumption may lead to failure of the Ricardian equivalence (Romer, 2006). Also, our results are in line with Easterly (2005). When we allow for non-linear growth effects of the public spending variables, the evidence tilts towards a positive growth effect of *DEDPY*, which strengthens the case for the failure of Ricardian equivalence at least regarding our country sample and period of examination. The above finding might also be due to the fact that there are no countries with excessive budget deficits for a long time in our sample. However, we should emphasize that budget deficits can not increase forever, since at some point higher taxes will be required for their financing, which will be at least partially distortionary, hampering growth.

Non fiscal policy variables

The relationship between per capita growth and initial income per capita/ lagged GDP growth (*C*) is negative implying conditional convergence between the countries of our sample. This is consistent with neoclassical growth models and recent empirical studies on convergence (see Casseli et al. 1996, Kalaitzidakis et. al, 2001, Doppelhofer et al., 2004).

Regarding human capital, we assess its role on growth by including two alternative measures of it in our model. The basic measure (*UPSEC)* is the percentage of the population aged 20 to 24 having completed at least upper secondary education, since this is the minimum education level for which there is enough variation in our sample, so as to be able to estimate possible growth effects. Also, it is used for reasons of comparability with earlier studies. Furthermore, we allow *UPSEC* to have lagged effects on growth. This variable has an ambiguous growth impact, which is in line with results of other research (Pritchett, 2001; Sianesi-Van Reenen, 2003, Barro-Sala-i-Martin, 2004). This

[18] See Table A2 for correlation of the models' variables.

implausible finding theoretically (Lucas, 1988, Romer, 1990, Grossman-Helpman, 1991) can be explained in several ways. Human capital presents serious measurement problems (Krueger-Lindhal, 2000). Specifically, it embraces complex characteristics that are difficult to quantify accurately. Also, educational measures are not often compatible across countries due to differences in schooling quality. Moreover, returns to education tend to be higher in countries with a better-educated labour force, as predicted by some growth models (Azariadis-Drazen, 1990). Also, the acquisition of educational skills is not linked with productivity in some cases – that is, education is not only an investment but also a consumption good for some individuals. In light of such problems, we use an alternative measure of human capital, i.e. the percentage of active population having completed tertiary education and employed in S&T occupations (*HRSTCOR*), because we think that it is a more accurate measure of productive human capital in developed countries like those in our sample. The latter has a statistically significant positive growth impact, i.e. a one standard deviation rise (4.4% of active population) implies a 1.1% increase in per capita growth.

As far as employment growth (*EMPGR*) is concerned, it has a positive association with per capita growth. This is expected, since labour is a factor of production in most growth models. Also, employment controls for business cycle effects on growth, so we can be reasonably confident, that the estimated growth effects of the rest of the variables included in our model are not contaminated by short-run factors.

Moreover, private investment (*PRIY*) is estimated to have a positive effect on growth. This is in line with both growth theory (McGrattan, 1998) and empirics (Levine-Renelt, 1992, Cooley-Ohanian, 1997, Dinopoulos-Thomson, 2000, Bond et al., 2004).

Furthermore, openness (*OPEN*), affects growth mostly positively or in a non-statistically significant way. The positive effect can be explained by international knowledge spillovers of R&D driven by trade (Coe-Helpman, 1995, Lichtenberg-Van Pottelsberghe de la Potterie, 1998, Coe et al., 1997). Also, an economy can grow more rapidly if its comparative advantage at the time of opening to trade is in industries with faster learning-by-doing (Lucas, 1988).

6. CONCLUSIONS

The composition of both sides of the government budget, spending and revenues, matters for balanced growth according to endogenous growth models. This paper takes into account explicitly both sides of the general government budget using the most recent consistent dataset. We also extend past work by disaggregating government expenditures in a more detailed way and accounting for cross-country heterogeneous growth non-linear effects of fiscal variables. We initially find that government outlays on infrastructure (economic affairs and general public services) and property rights protection (defense, public order-safety) exert a positive impact on per capita growth. Also, government expenditures on human capital enhancing activities (education, health, housing-community amenities, environment protection, recreation-culture-religion) and social protection do not have a significant effect on growth. However, when public expenditures are disaggregated further and heterogeneity across countries along with nonlinearities are taken into account, we have additionally that government outlays on education have a positive effect on per capita growth which strengthens with initial education, while defense and social protection have a growth-enhancing impact which strengthens with income per capita. Finally, distortionary taxation depresses growth. Here, we should note that higher levels of the above expenditure types will have their full growth benefits for EU economies only if they are financed by increases in non-distortionary taxes. These findings are robust to changes in specification and estimation methodology.

We close with future extensions. We could update our data set including more recent data and more countries, when this is possible. Afterwards, we could further disaggregate government spending in order to explore the growth impact of each spending category in detail. We could also apply additional estimation methods, e.g. panel cointegration to distinguish the short and long run growth effects of the various categories of public spending and revenues. Finally, we could investigate the role of public sector efficiency and policy volatility in the relation between fiscal policy and growth. We leave these for future research.

APPENDIX

A1. Variable definitions

Y: GDP at market prices, Euro per inhabitant (at 1995 prices and exchange rates)

YG: growth rate of real GDP per capita equal to $\ln Y_t - \ln Y_{t-1}$

Y0: initial GDP at market prices, Euro per inhabitant (at 1995 prices and exchange rates)

GEDUY: General government expenditure on Education (Percentage of GDP)

GHEAY: General government expenditure on Health (Percentage of GDP)

GHOCOY: General government expenditure on Housing and Community amenities (Percentage of GDP)

GENPRY: General government expenditure on Environment Protection (Percentage of GDP)

GRRY: General government expenditure on Recreation, Culture and Religion (Percentage of GDP)

GSPROY: General government expenditure on Social protection (Percentage of GDP)

GEAFY: General government expenditure on Economic Affairs (Percentage of GDP)

GPUBSY: General government expenditure on General Public Services (Percentage of GDP)

GORSFY: General government expenditure on Public Order and Safety (Percentage of GDP)

GDEFY: General government expenditure on Defence (Percentage of GDP)

TIWY: Current taxes on income, wealth (Percentage of GDP)

CAPTY: Capital taxes (Percentage of GDP)

TPRIMY: Taxes on production and imports (Percentage of GDP)

ACSCY: Actual social contributions (Percentage of GDP)

DTY: Distortionary taxation as share of GDP (*TIWY+ CAPTY+ ACSCY*)

DEDPY: Net lending (+)/Net borrowing (-) under the EDP (Excessive Deficit Procedure) (Percentage of GDP)

GHY: *GEDUY+GHEAY+GHOCOY+GENPRY+GRRY*, General government expenditure on human capital accumulation (Percentage of GDP)

GINFY: GEAFY + GPUBSY, General government expenditure on infrastructure (Percentage of GDP)

GPRY: GDEFY+ GORSFY, General government expenditure on property rights protection (Percentage of GDP)

DTY: TIWY+ CAPTY+ ACSCY: Distortionary taxation (Percentage of GDP)

UPSEC: Youth education attainment level - total - Percentage of the population aged 20 to 24 having completed at least upper secondary education

HRSTCOR: Human recourses in science and technology-core, i.e. persons who have completed tertiary education and are employed in S&T[19] occupations, percentage of active population

EMPGR: Employment growth - total - Annual percentage change in total employed population

PRIY: Business investment - Gross fixed capital formation by the private sector as a percentage of GDP

XY: Exports of goods and services (Percentage of GDP)

MY: Imports of goods and services (Percentage of GDP)

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[19] Science and technology occupations (professionals, technicians and associate professionals). See definitions in the Eurostat web site for details.

OPEN: *XY+MY*, index of openness
UPSEC0: initial *UPSEC*
HRSTCOR0: initial *HRSTCOR*
MOTWAY0: initial length of motorways (km)/area
*GEDUYY0: GEDUY*Y0*
*GHYRY0: (GHEAY+GHOCOY+GENPRY+GRRY)*Y0*
*GEDUYUS0: GEDUY*UPSEC0*
GHYRUS0: (GHEAY+GHOCOY+GENPRY+GRRY) UPSEC0*
*GEDUHC0: GEDUY*HRSTCOR0*
*GHYRHC0: (GHEAY+GHOCOY+GENPRY+GRRY)*HRSTCOR0*
GINFYM0: GINFY MOTWAY0*
*GDEFYY0: GDEFY*Y0*
*GORSFYY0: GORSFY*Y0*
*GSPROYY0: GSPROY*Y0*

A2. List of countries

The countries included in our sample are the following:
Belgium, Denmark, Germany, Ireland, Greece, France, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden, U.K.

Table A1. Descriptive statistics

Variable	Mean	Std Deviation	Minimum	Maximum
YG	2.191	2.236	-6.968	13.280
Y0	18209.75	5976.567	8000	29800
GEDUY	5.529	1.284	2.5	8.2
GHEAY	5.840	1.288	0.9	7.7
GHOCOY	0.933	0.584	0.1	6.3
GENPRY	0.629	0.288	0.1	1.5
GRRY	1.046	0.435	0.1	2.2
GSPROY	18.422	4.122	7.8	28.4
GEAFY	4.656	1.198	1.3	11.1
GPUBSY	8.4	3.188	3.7	21
GORSFY	1.476	0.495	0.001	2.8
GDEFY	1.729	0.938	0.3	6
GHY	13.977	2.735	4.8	18.3
GINFY	13.056	3.457	7	25.1
GPRY	3.204	1.005	1.2	6.5
TIWY	14.681	5.127	6.4	31.2
CAPTY	0.239	0.206	0.001	1.9
TPRIMY	13.653	1.782	10.4	18.2

ACSY	11.913	4.305	1.1	18.9
DTY	26.833	4.628	16	35.8
DEDPY	-2.04	3.396	-9.5	6.9
UPSEC	73.923	12.121	35	89.3
HRSTCOR	15.045	4.433	6.23	24.52
EMPGR	1.002	1.823	-7.1	8.6
PRIY	17.49	2.333	11.3	24.5
XY	48.556	29.078	15.2	144.6
MY	45.143	23.315	19.4	118.3
OPEN	93.699	52.120	37.5	262.9

Table A2. Correlations of models' variables

	Y0	*GHY*	*GINFY*	*GPRY*	*GSPROY*	*DTY*	*DEDPY*	*UPSEC*
Y0	1.0000							
GHY	0.4016	1.0000						
GINFY	-0.1563	-0.1545	1.0000					
GPRY	-0.5703	-0.1612	0.0600	1.0000				
GSPROY	0.5505	0.3984	0.2574	0.0714	1.0000			
DTY	0.6692	0.5395	0.2941	-0.1195	0.7899	1.0000		
DEDPY	0.5074	0.2674	-0.3836	-0.4550	0.0124	0.3375	1.0000	
UPSEC	0.1682	0.0500	0.1012	0.0204	0.3338	0.3226	0.2522	1.0000
HRSTCOR	0.5074	0.2027	-0.1493	-0.1359	0.2702	0.4321	0.5552	0.4175
EMPGR	0.0497	-0.1763	-0.3211	-0.3550	-0.4844	-0.2908	0.4740	-0.0421
PRIY	-0.1332	0.0341	-0.0339	-0.3094	-0.3181	-0.1880	0.0306	-0.2385
OPEN	0.4082	-0.0165	-0.2946	-0.6699	-0.4442	-0.1234	0.5345	-0.0141

	HRSTCOR	*EMPGR*	*PRIY*	*OPEN*
HRSTCOR	1.0000			
EMPGR	0.0892	1.0000		
PRIY	-0.3899	0.1867	1.0000	
OPEN	0.4141	0.5537	0.1050	1.0000

Table A3. Estimation Results-coefficient homogeneity

Explanatory Variables	OLS Estimates[1]	FE Estimates	AB Estimates[2]	AB Estimates[3]	AB-BB Estimates[3]	AB-BB Estimates[3]
	(1)	(2)	(3)	(4)	(5)	(6)
C	0.0002 (0.93)		-0.544*** (-3.52)	-1.111*** (-2.91)	-0.938*** (-2.69)	-0.932** (-2.34)
GHY	0.009 (0.51)	0.168* (1.93)	-1.597 (-1.55)	-2.216 (-1.37)	-0.132 (-0.31)	0.220 (1.39)
GINFY	0.082* (1.96)	0.154** (2.00)	-1.083 (-1.07)	-1.664** (-1.97)	0.805*** (3.12)	0.759*** (2.62)
GPRY	0.184*** (3.01)	0.024 (0.13)	5.077* (1.68)	2.061* (1.87)	1.994** (2.18)	8.949* (1.88)
GSPROY	0.036 (1.11)	0.151 (1.52)	0.459 (0.95)	-0.407 (-0.84)	0.515 (1.41)	-0.290 (-0.66)
DTY	-0.077** (-2.01)	-0.096 (-1.20)	-0.901*** (-3.12)	1.821 (1.46)	-0.544***[5] (-2.85)	-1.516** (-2.51)
DEDPY	0.035 (1.17)	0.091 (1.33)	-0.978*[4] (-1.71)	-1.292** (-2.03)	0.381*** (2.57)	0.585** (2.37)
UPSEC	-0.0002 (-0.04)	-0.034*** (-2.76)	-0.556 (-1.60)	-0.083 (-1.63)	0.033 (0.72)	
HRSTCOR						0.246*** (2.84)
EMPGR	0.748*** (5.41)	0.330* (1.69)	2.064* (1.70)	2.614** (2.53)	1.333** (2.09)	0.401***[6] (3.29)
PRIY	-0.034 (-0.27)	0.287* (1.71)	2.769*** (2.69)	1.139** (2.16)	0.986*** (2.66)	1.741* (1.68)
OPEN	0.003 (0.37)	0.019 (0.90)	-0.040 (-0.23)	-0.157* (-1.77)	0.074** (2.07)	0.056* (1.69)
Obs.	111	111	94	94	113	127
R^2	0.364	0.327				
Hausman test (p- value)[7]		0.017				
Sargan Test (p-value)[8]			1.000	1.000	1.000	1.000
Autocorrelation of 2nd order (p-value)[9]			0.969	0.108	0.601	0.326

Note: Dependent variable GDP per capita growth in country i (i =1,…,14) in period t (t =1990,…,2006). t-statistics, z-statistics are reported in parentheses for OLS/FE and AB/AB-BB estimations respectively; *, **, *** denote 10%, 5% & 1% significance levels respectively. [1]OLS estimates heteroskedasticity consistent.[2] Dependent variable and explanatory variables lagged up to 14 periods were used as instruments. [3] Dependent variable lagged up to 14 periods was used as instrument. [4] *DEDPY* lagged up to 1 period used. [5] *DTY* lagged up to 2 periods used. [6]*EMPGR* lagged up to 2 periods used. [7]The Hausman statistic is distributed as a chi-square whose critical value with df=10 is 18.307 (p-value: 0.05) and the null hypothesis is that the difference in RE/FE coefficient estimates is not systematic. [8] The null hypothesis is that the instruments used are not correlated with the residuals.[9]The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation.

Table A4. Estimation Results-coefficient heterogeneity

Explanatory Variables	OLS Estimates[1]	FE Estimates	AB Estimates[2]	AB Estimates[3]	AB-BB Estimates[3,4]	AB-BB Estimates[3,5]
	(1)	(2)	(3)	(4)	(5)	(6)
C	0.0003* (1.77)		-1.705** (-2.22)	-22.207* (-1.83)	6.104** (2.07)	-0.836** (-2.13)
GEDUYY0	0.0000001 (0.40)					
GHYRY0	-0.00002 (-0.64)					
GEDUYUS0		0.011* (1.74)			0.108** (2.25)	0.002 (0.54)
GHYRUS0		0.001 (0.80)			0.156** (2.29)	0.015** (2.05)
GEDUYHC0			0.761** (1.99)	0.887* (1.64)		
GHYRHC0			0.545* (1.94)	-2.345* (-1.72)		
GINFYM0	-0.646 (-1.31)	7.581*** (2.84)	6.945 (0.36)	-839.978* (-1.72)	110.934** (2.43)	34.992*** (3.09)
GDEFYY0	0.00001** (2.04)	0.00000003 (0.02)	0.003** (2.05)	-0.00006 (-0.83)	0.0004*** (2.63)	0.0002*** (2.94)
GORSFYY0	-0.00002 (-1.07)	0.00008* (1.66)	-0.003** (-2.22)	0.008* (1.93)	-0.001** (-2.15)	-0.0001 (-0.77)
GSPROYY0	-0.0000002 (-0.89)	0.00002*** (3.27)	-0.0003** (-2.07)	0.002** (1.98)	0.00003*** (2.75)	0.00007*** (3.18)
DTY	0.028 (1.06)	-0.129* (-1.93)	-15.415** (-2.08)	-36.690** (-2.04)	-3.035*** (-2.64)	-1.822*** (-3.21)
DEDPY	-0.065* (-1.93)	0.176*** (2.66)	0.687* (1.66)	13.612** (2.10)	1.297** (2.42)	0.957*** (2.89)
UPSEC	0.002 (0.38)	-0.054*** (-3.89)		4.545* (1.69)		
HRSTCOR			-7.708** (-2.21)		2.650** (2.26)	2.458*** (2.89)
EMPGR	0.546*** (3.55)	0.40009** (2.21)	1.781** (2.50)	36.649** (2.01)	6.782** (2.45)	0.921*** (3.00)
PRIY	0.058 (0.29)	0.285* (1.70)	5.984** (2.23)	18.355* (1.82)	-15.333** (-2.24)	-0.584 (-0.81)
OPEN	0.013 (1.07)	0.011 (0.38)	0.809** (2.09)	-3.860* (-1.83)	0.363** (2.50)	-0.132** (-2.32)
Obs.	111	111	92	81	127	127
R^2	0.368	0.400				
Hausman test (p- value)[6]		0.000				
Sargan Test (p-value)[7]			1.000	1.000	1.000	1.000
Autocorrelation of 2nd order (p-value)[8]			0.429	0.539	0.751	0.199

Note: Dependent variable GDP per capita growth in country i (i =1,…,14) in period t (t =1990,…,2006). t-statistics, z-statistics are reported in parentheses for OLS/FE and AB/AB-BB estimations respectively; *, **, *** denote 10%, 5% & 1% significance levels respectively. [1]OLS estimates heteroskedasticity consistent.[2] Dependent variable and explanatory variables lagged up to 14 periods are used as instruments. [3] Dependent variable lagged up to 14 periods is used as instrument. [4] *EMPGR*, *GEDUYUS0*, *GHYRUS0* lagged up to 2 periods used. [5] *GORSFYY0* lagged up to 1 period, *EMPGR*, *GEDUYUS0*, *GHYRUS0* lagged up to 2 periods used. [6]The Hausman statistic is distributed as a chi-square whose critical value with df=8 is 15.507 (p-value: 0.05) and the null hypothesis is that the difference in RE/FE coefficient estimates is not systematic. [7] The null hypothesis is that the instruments used are not correlated with the residuals.[8]The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation.

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